General Ecology, Inc. – First Need® Deluxe

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Device Information

The General Ecology, Inc. First Need Deluxe is a handheld pump water treatment device utilizing what the manufacturer calls a proprietary "structured matrix" media for pathogen reduction. According to the manufacturer, the reduction process consists of microfiltration (0.1 µm nominal, 0.4 µm absolute pore size), chemical adsorption, and electrochemical attraction. The proprietary media consists of a block of activated carbon treated to enhance retention of viruses and other microorganisms by way of association with the media surface. The device consists of inlet tubing with pre-filter, enclosed canister containing the media, and a hand pump. The bottom of the canister is fitted with threads to attach directly to wide mouth drinking bottles, such as Nalgene® bottles, or the device can be held above any container suitable for receiving the treated water. An adaptor is available to allow the canister to directly attach to the fill port of personal hydration systems (e.g., Camelbak®). Using a bag included with the device, water may be produced by gravity flow without the need for pumping in what the manufacturer terms "matrix pumping."

Effectiveness Against Microbial Pathogens

Results from an independent study (references 1, 2) show that when challenged against the U.S. Environmental Protection Agency (USEPA) Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 3), this device meets the pathogen log reduction requirements, shown below, based on geometric averages of three identical devices for a production capacity of 378 L per device at a flowrate of 0.476 L/min. Pathogen reduction is based on size exclusion and electrostatic attraction as shown in the Table. Because this device was not tested according to the manufacturer stated flowrate and production capacity, one √ is assigned for pathogen reduction (click here for rating explanation), indicating that expert opinion expects this device to meet the requirements of reference 3, but no data was available to confirm pathogen reductions.

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® Camelbak is a registered trademark of CamelBak Products, Inc., Petaluma, CA. Use of trademarked products does not imply endorsement by the U.S. Army, but is intended only in identification of a specific product.

Table. Expected Performance Against Microbial Pathogens.

Microbial Pathogen Type	Expected Disinfection Capability	Evaluation Rating	Primary Pathogen Reduction Mechanism
Bacteria	> 6-log	√	size exclusion
Viruses	> 4-log	√	electrostatic attraction
Giardia cysts	> 3-log	√	size exclusion
Cryptosporidium oocysts	> 3-log	√	size exclusion

Production Rate and Capacity

Inherent to the production rate and capacity of filtration devices is the quality of the raw water source. Manufacturer stated production rate is 1.75 L/min, and overall capacity of the media canister is 500 L. Capacity will vary widely with raw water turbidity. The flowrate used during microbial pathogen studies was 0.476 L/min, far below the 1.75 L/min manufacturer stated flowrate recommended during normal operation.

Cleaning, Replacement, and End of Life Indicator

When pumping becomes difficult the canister can be backwashed according to manufacturer instructions. The hand pump is attached to the outlet of the canister and clean water is pumped in the opposite direction of normal operation. The manufacturer recommends passing dilute bleach through the device following backwash. Once the canister has reached the 500 L production capacity, or when backwashing does not restore flow, the canister must be discarded and replaced with a new unit. The hand pump and housing can be washed with mild detergent and clean water. Device instructions state to conduct integrity testing prior to each trip, and if device freezes or is subject to shock loads. Integrity testing consists of adding the provided blue food dye to water then pumping it through the device. If even the faintest of blue color is present in the processed water, the canister must be replaced.

Weight and Size

The dry weight of the device is 430 grams (does not include container for treated water). Dimensions are as follows:

Overall (height x width x length)	13 cm x 7 cm x 16 cm
Canister (diameter x height)	7 cm x 10 cm
Pump length	14 cm
Inlet tubing	91 cm
Prefilter length	8 cm

Cost

First Need Deluxe	$93.00
Replacement canister	$42.00
Wide mouth adaptor for hydration packs	$5.25
Narrow mouth adaptor	$5.25

Device Evaluation

The General Ecology, Inc., First Need Deluxe has been shown, based on independent published data (reference 1), to be capable of meeting the requirements of reference 3 at a reduced flowrate. Bacteria and cyst reduction, based on size exclusion by microfiltration, is a proven technology and an intact membrane will effectively reject these microbes (reference 4). Virus removal by the "structured matrix" is based on electrostatic attraction, and although shown to be effective under laboratory conditions, is not considered as consistent of a reduction mechanism as size exclusion. Virus attraction to solid surfaces is highly affected by virus type, charge, and water pH, and therefore, removal efficacy is highly variable (reference 5). There also exists the possibility for release of previously attracted viruses from this media under certain water quality conditions. Since this device utilizes electrochemical adsorption, the flowrate through the device can have a dramatic effect on pathogen reduction. To ensure safe water production, the device should not be operated above the flowrate of 0.476 L/min or beyond the production capacity of 378 L, the flowrate and capacity shown to meet the above pathogen reductions (references 1,2). Users cannot be expected to regulate flowrate during production, adding uncertainty to the expected virus reduction claims, and stressing the importance of laboratory testing at device recommended conditions. The filter media contains activated carbon that uses adsorption for virus removal. The carbon has a finite number of sites for virus adsorption and, once exhausted, the ability of the device to remove viruses is questionable. This device requires no chemical addition and no wait time prior to water consumption. There is no indicator of process failure on a real-time basis, and end of device useful life is based on integrity testing, filter clogging, or by the user keeping track of the volume of water purified. Inherent to treatment devices utilizing small pore size membranes is the likelihood of clogging when processing highly turbid raw water. Although this device uses a pre-filter and is able to be backwashed, this inherent disadvantage is still valid. The manufacturer claims that "matrix pumping" (gravity flow) will work even if canister is clogged. According to manufacturer instructions, during backwashing of

the canister the pump influent is to be placed into clean water. This requires the user to have access to an additional clean container, as once the pump inlet is placed into the clean container it is now contaminated from the pump. The user's drinking water vessel should not be used as the source for backwashing. Manufacturer recommendations require the user to supply chlorine bleach for use during backwashing for long term storage. When backwashing, pumping in the reverse direction through the canister can possibly contaminate the effluent side of the canister with residue in the pump. This cross contamination is possible with or without bleach if chlorine resistant organisms are present in the pump. Integrity testing of the device, recommended before expected use and after freezing of device, entails visual inspection of product water after placing blue dye in the raw source. The ability of the user to detect slight color change is uncertain, making this a questionable technique for determining device failure. Device instructions state to store device in clean, dry area away from fumes but gives no storage life.

Advantages

- Independent testing confirms bacteria, virus, and protozoan reduction in accordance with the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers (reference 3) but at a reduced flowrate.
- No chemicals required.
- No wait time prior to consumption.
- Device capable of backwashing to restore clogged filter.

Disadvantages

- Electrochemical virus attraction by proprietary media is not widely proven technology and efficacy may be affected by raw water quality.
- Testing for pathogen reduction efficacy was not conducted at manufacturer stated flow conditions, making applicability of results to actual use questionable.
- Mechanical sieving inherently prone to clogging with high turbidity waters.
- Backwashing requires access to a clean container and household bleach with a potential for cross contamination.
- No real-time indicator of process failure.

References

1. Gerba, C.P., and Naranjo, J.E., 2000. Microbiological Water Purification Without the Use of Chemical Disinfection. *Wilderness and Environmental Medicine*. 11:12-16.

2. Independent laboratory results of tests showing compliance with the USEPA Guide Standard and Protocol for Testing Microbiological Water Purifiers, 1995. Provided by General Ecology.

COTS Purifiers – Army Study Program, Project No. 31-MA-03E0-05.

3. USEPA, 1989. Guide Standard and Protocol for Testing Microbiological Water Purifiers. *Federal Register*. 54:34067.

4. U.S. Army Center for Health Promotion and Preventive Medicine, 2005. *Technical Information Paper; Filtration in the Use of Individual Water Purification Devices*, Aberdeen Proving Ground, MD.

5. Gerba, C.P., 1984. Applied and Theoretical Aspects of Virus Adsorption to Surfaces. *Advances in Applied Microbiology*. 30:133-168.